Research Progress 1973

Annual Report

PSW FOREST AND RANGE
EXPERIMENT STATION
SEP 13 1974
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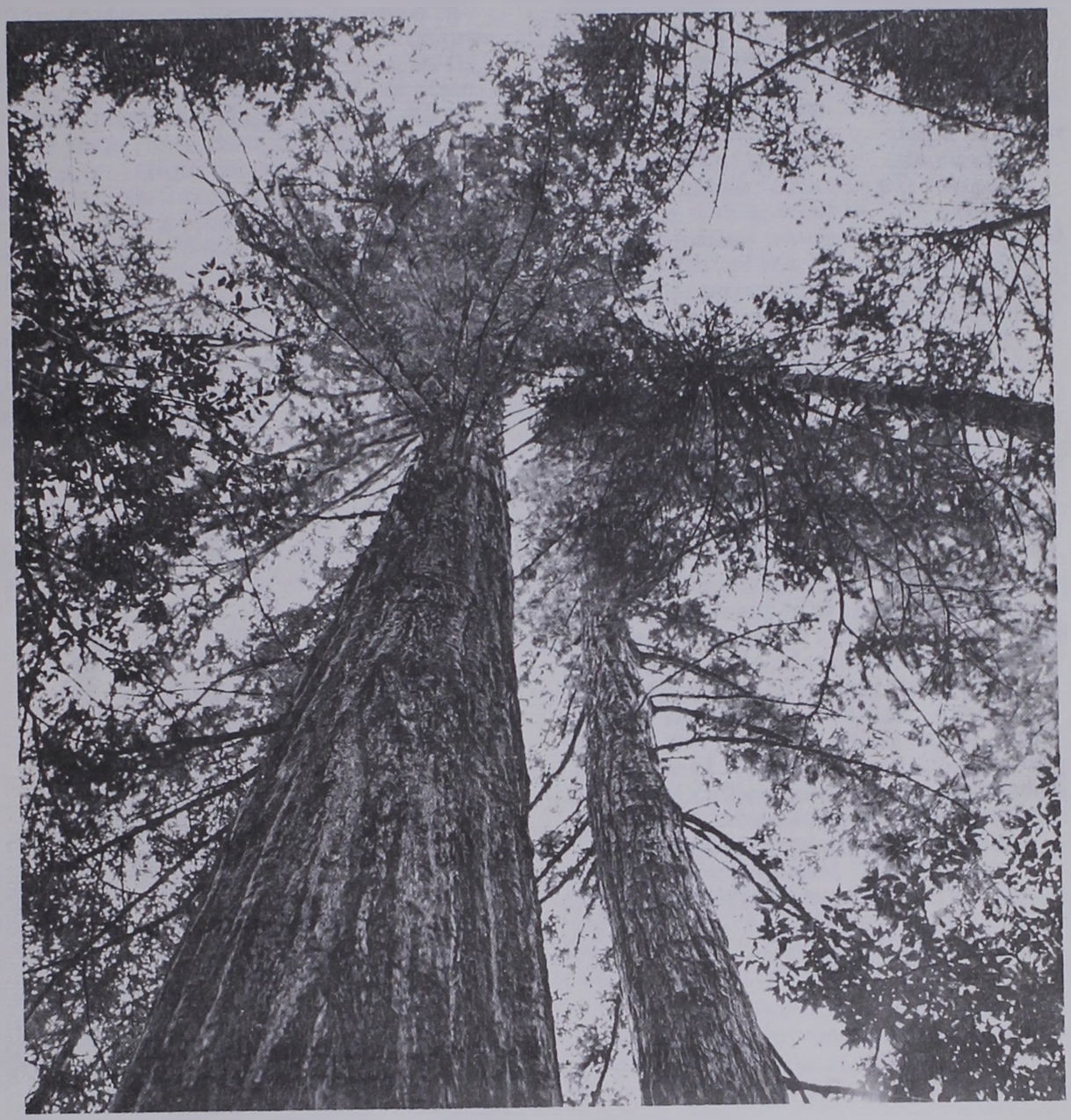
Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Forest Service U.S. Department of Agriculture



Wheeler Creek Research Natural Area
for dedication story, see page 10

FROM THE DIRECTOR

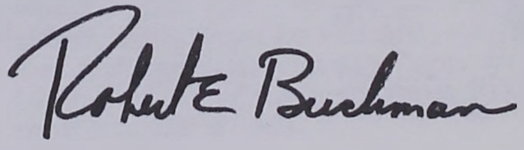
I welcome this opportunity to bring you up to date on important research results and new directions in our research program. During the past year, the Douglas-fir tussock moth occupied more of our attention than any other single research effort. At one time, more than 20 scientists were working on various aspects of the problem. The current outbreak is the worst ever recorded, having spread to some 800,000 acres in Oregon, Washington, Idaho, and Montana.

Because of the severity of this outbreak, much attention has been focused on the research program, and on our continuing effort to find alternatives to DDT. The very promising results of our work are outlined later in this report.

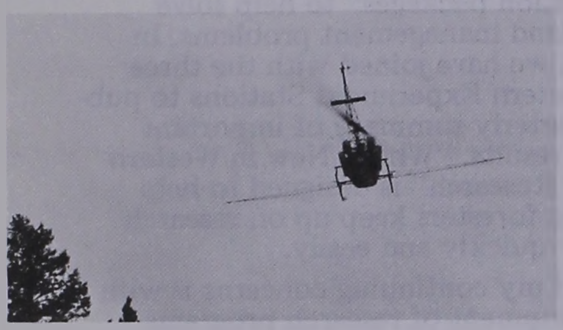
The Station now has about 125 scientists and a total staff of about 270. Each year we complete and publish some 250 scientific and professional papers. Despite this, we still find that much of the available technical information is not being used. One of our concerns now is to help speed the transfer of this information in a usable form. We are currently exploring several ways to help solve this communication problem. Through a cooperative effort of the various agencies that have some responsibility for extension work, we hope to develop complete new "information packages" to help solve specific land management problems. In addition, we have joined with the three other western Experiment Stations to publish a quarterly summary of important research results. "What's New in Western Forestry Research" is designed to help practicing foresters keep up on research progress—quickly and easily.

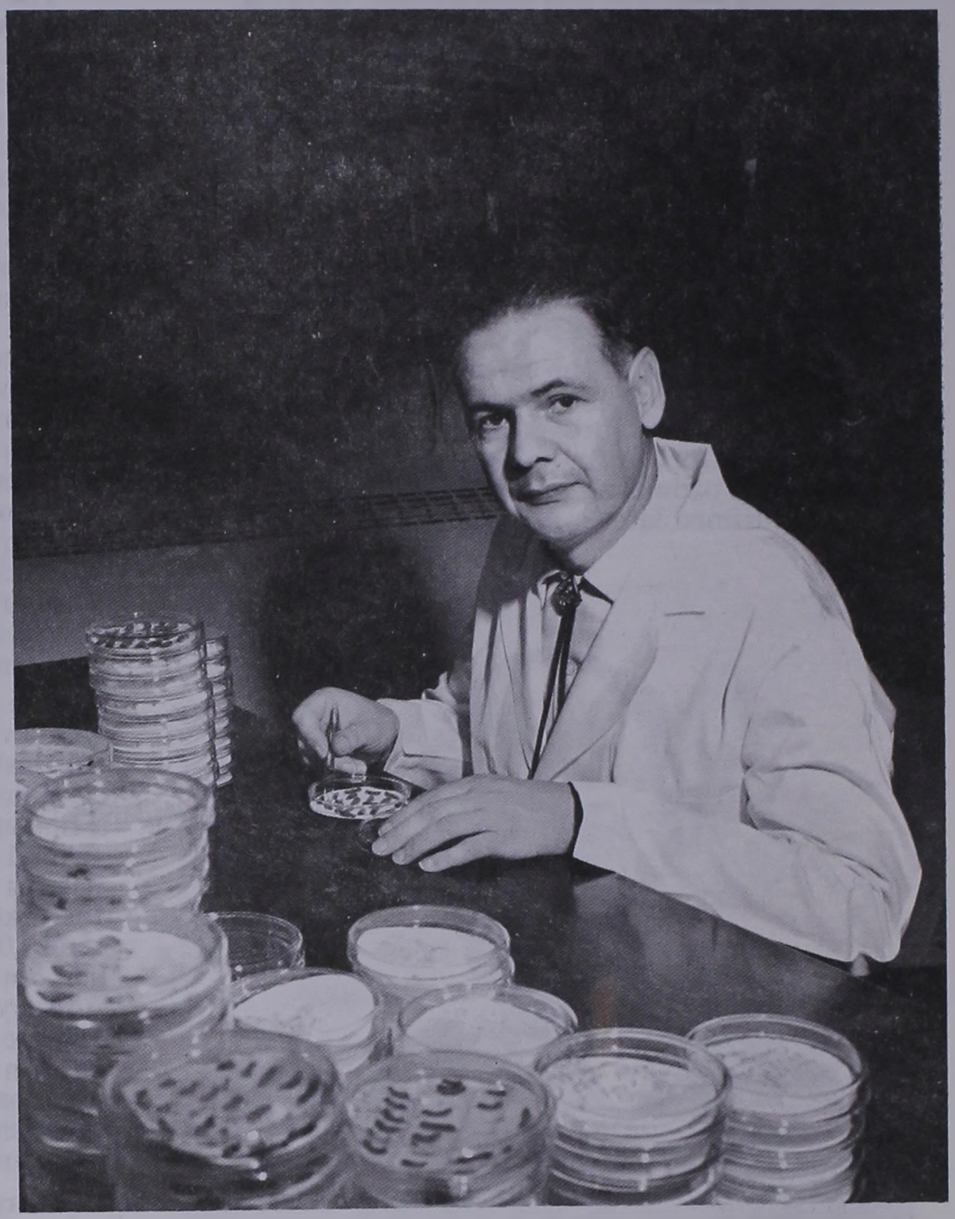
One of my continuing concerns is with the development of research programs in Alaska. Some 80 million acres of public domain lands in Alaska are currently being apportioned among the several federal agencies. In addition, Alaska natives will claim 40 million acres, and the State of Alaska will administer more than 100 million acres. Increased growth and development accelerate the need for forestry research programs in Alaska. Many of the problems that have faced Oregon and Washington are just now emerging there. We are putting strong emphasis on strengthening programs at Fairbanks and Juneau to meet those needs.

There have been many significant developments during the past year. I invite you to read the report, and write or call me or any of my staff about programs that interest you.



Robert E. Buckman
Director





The tussock moth virus is sprayed by helicopter in experiments to see if it will control epidemics of this forest insect pest. Tussock moth, lower left, has been killed by the virus. Right: an electron microscope photograph of the virus shows its structure—a polyhedron form which protects the many virus bundles from sunlight.

Clarence G. Thompson, entomologist, directs the work at the Forestry Sciences Laboratory in Corvallis, Oregon. Goal of the research is to develop safe and effective biological controls.

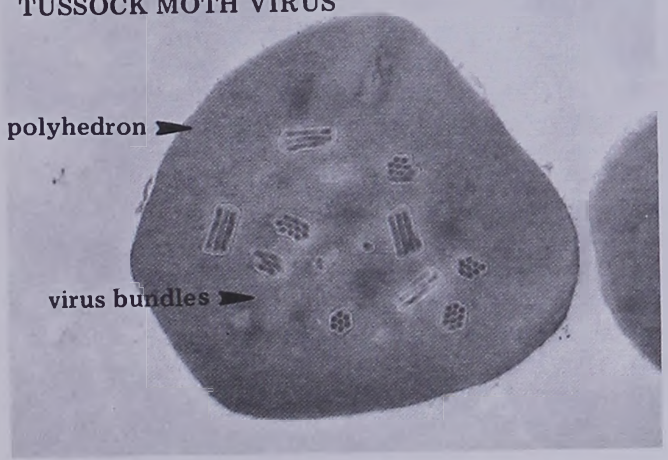
RESEARCH PROGRESS

1973 was the year of the tussock moth. The worst epidemic of this destructive forest defoliator ever recorded spread through some 800,000 acres of timberland in eastern Oregon and Washington, Idaho, and Montana. The cause of the epidemic is not completely known, but ecologists believe that the quality of the timber stands may have something to do with their susceptibility to damage. While part of the answer to the tussock moth problem lies in improving the health and vigor of the forest, we also need better ways to predict outbreaks and stop them at an early stage.

The Forest Service has conducted research on the biology, ecology, and control of the tussock moth for many years. The earliest biological studies date back to 1927, before the insect work of the Bureau of Entomology and Plant Quarantine was transferred to the Forest Service. A major effort to find alternatives to DDT for controlling the tussock moth has been underway since 1964—eight years before the ban on DDT.

Over the years much has been learned about the biology of the tussock moth—its life cycle, feeding habits, and population trends. In 1973, our entomologists published a report on the major outbreaks of the tussock moth in Oregon and California. Here, for the first time, they outlined case histories of major outbreaks, the cyclic nature of epidemics, and the role that natural biological agents play in their decline.

TUSSOCK MOTH VIRUS



Progress Made in Biological Controls

In 1964, we began to study the use of biological agents to control the tussock moth. Many of the natural parasites, predators, and diseases which attack the tussock moth have now been identified. One of these, a nucleopolyhedrosis virus, shows exceptional promise. It is the virus that often causes the natural collapse of tussock moth outbreaks. Scientists at the Forestry Sciences Laboratory in Corvallis, Oregon, have mixed it into formulations suitable for spraying on the forests. In field tests this year, the virus achieved population reductions as high as 99.9 percent when sprayed on small plots. The virus is both effective and environmentally safe. A commercially available bacterium, *Bacillus thuringiensis* (which is not native in tussock moth populations) was also tested in 1973. It achieved population reductions as high as 98 percent.

Some problems must be solved before we can recommend either the virus or bacillus for operational use. For example, we need to develop improved formulations and methods of application, work out the techniques for mixing large quantities, train field personnel in handling and use of biological materials, and arrange for commercial production of enough virus to spray large acreages. Plans are underway to do that work in 1974.

Sex Attractant Sought for Tussock Moth

One of the continuing problems with tussock moth outbreaks is that they build up very rapidly. By the time foresters are aware the insect population is increasing, considerable damage has already been done. We need better early warning systems to detect outbreaks while they are still small. Through cooperative research with the Oregon Graduate Center at Beaverton, Oregon, we are exploring the possibility of using the sex attractant of the tussock moth for this purpose. Early results indicate that the attractant can be isolated, synthesized, and perhaps deployed as a "survey" tool to keep track of the number of tussock moths in the woods.

Insecticides Tested

At the same time we began biological control work in Corvallis, the Forest Service established an Insecticide Evaluation Project in Berkeley, California, to find chemical alternatives to DDT for forest insect control. Screening of potential insecticides against the tussock moth was started in 1966. In the intervening years, some 80 insecticides have been tested in the laboratory. Of those, about half show significant toxicity to the larvae of the moth.

In 1972, the first year an outbreak afforded an opportunity to field test these materials, the insecticide Zectran was tested in Oregon and Washington. Results were only moderately encouraging. In 1973, four of the most promising insecticides were tested. These included carbaryl, Dylox, Zectran, and bioethanomethrin, a synthetic pyrethrin. This year more extensive tests will be conducted with carbaryl, Dylox, and with DDT.

The objective of these studies is to find suitable alternatives to DDT—either biological or chemical controls that will be effective enough to do the job and cause little or no damage to other parts of the environment. We are especially encouraged with the results of the tests with the virus and bacillus and plan to pursue this research aggressively.

Development of new and safer insecticides and biological controls is only part of the complex job of developing substitutes for DDT. Once materials are available for testing, the equipment and methodology must be developed for aerial application. Our researchers have now completed the basic work necessary for applying the insecticides and biological agents on a small-scale, experimental basis. The next step is to develop equipment and procedures for mixing, handling, and application on an operational basis.

Sex Attractant Identified for Pine Shoot Moth

Considerable space has been spent outlining research progress on the tussock moth. But an equally fascinating story can be told about another insect—one we hope you never hear very much about. This is the European pine shoot moth, a pest of pine forests in Europe. First found in the United States in 1914, it has spread on nursery stock throughout the East, Midwest, Lake States, and southern Ontario, Canada.

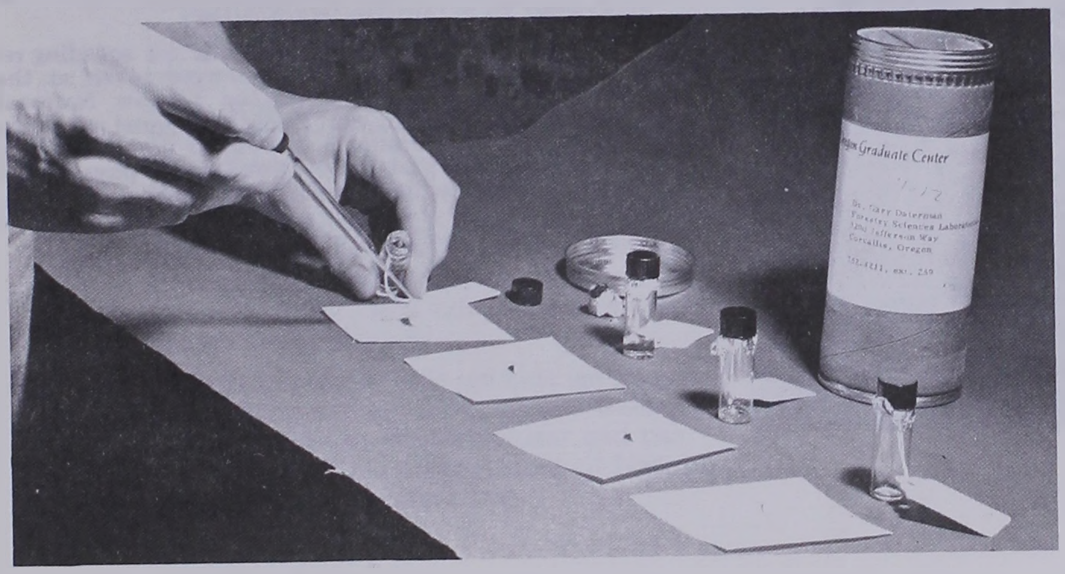
In 1927, it was found in western Canada, and in 1959 turned up in Washington state, where it has caused serious damage to ornamental and plantation pines. After 14 years, the insect has still not been eradicated from the Pacific Northwest. But researchers are hopeful it can be kept from spreading to the region's pine forests.

This year, our entomologists working in cooperation with chemists at the Oregon Graduate Center have achieved a major research breakthrough by identifying the sex attractant of the shoot moth as trans-9-dodecenyl acetate. A synthetic form is now available and in 1974 cooperating state agencies in Oregon and Washington plan to deploy 1500 traps containing the attractant in a "survey" program to detect possible infestation centers.

Thinning Stops Mountain Pine Beetle

Epidemics of the mountain pine beetle almost always occur in timber stands that are very dense. Researchers began an experiment in eastern Oregon in 1967 to see if thinning might be a way to control the pest in second-growth ponderosa pine. It seems to work. In the five years since the study was begun, mortality from beetles in the unthinned plots was some 15 times greater than in the thinned plots. Several levels of thinning were tried. At spacings 18 feet and over, mortality went down to zero. Entomologists expect the difference between mortality in thinned and unthinned stands to be even greater as time goes on. But it will be many more years before we'll know which of the several thinning treatments is best.

In the laboratory, Gary E. Daterman experiments with compounds to identify the sex attractant of the Douglas-fir tussock moth (upper right). Sex attractant of the European pine shoot moth (lower right) was identified and reproduced chemically in the laboratory of the Oregon Graduate Center during 1973. Below, Daterman prepares compounds for testing on the tussock moth.



Trees grown in containers hold promise for speeding reforestation efforts. These pictures were taken at the Beaver Creek Seed Orchard in the Siuslaw National Forest where researchers and Forest personnel are working together to determine how best to use containers. Nurseryman John Kirk (above) and plant physiologist Pete Owston check the growth of young hemlock trees. Seeds are planted in styrofoam containers, with the "plugs" releasing easily for planting.

Containerized Seedlings Evaluated

In cooperation with the Pacific Northwest Region of the Forest Service, we have begun a five-year research and development program to evaluate the success of containerized tree seedlings. The experimental nursery is located near Corvallis in the Siuslaw National Forest. We already know that good-sized seedlings can be container-grown in six months or less, that production can be expanded on short notice, that most species can be grown successfully in containers, and that containers provide an excellent means for producing seedlings from small amounts of seed. But there are many things we don't know yet; for example, how to harden seedlings for different seasons and planting situations, survival and growth rates compared with bare-root stock, and the mechanics of transporting and planting containerized trees. Preliminary studies indicate that containerized Douglas-fir seedlings perform better than bare-root nursery stock on favorable sites. Results with western hemlock, a species which has been difficult to handle in the past, appear particularly promising.

New Timber Yield Tables in Preparation

There is increasing demand for estimates of the timber yields possible under various intensities and forms of forest management. This information is important, for example, in order to accurately predict future timber supply.

Preliminary estimates of potential yields of Douglas-fir under thinning, precommercial thinning, and fertilization were prepared for the National Timber Review. This information is now being revised and will be worked into a set of interim yield tables for Douglas-fir in the Pacific Northwest. A two-year research effort has also been initiated in cooperation with Weyerhaeuser to develop even more accurate yield tables for managed stands of Douglas-fir.

Another study will provide interim yield estimates for Sitka spruce/western hemlock stands. Weyerhaeuser and the Washington State Department of Natural Resources are cooperating.

Central Washington Timber Resources

The timber resources of Central Washington contribute substantially to the area's economy. Approximately 4.4 million acres, or 30 percent of the land, is classified as commercial forest. A recent report (Resource Bulletin PNW-45) brings together available information on the forest resources of this eight-county region. The study also outlines the impact of recreation pressure on the region's forest lands. Already special timber harvest practices are required in one-third of the commercial forest land in the National Forests in order to meet landscape management criteria. In the future, even more areas may be put in this category or withdrawn entirely from timber harvest.

Estimating Site Productivity

It is important for foresters to be able to estimate the productivity of a given piece of forest land—even if it is not currently supporting timber. In the past, site index (an estimate of productivity) has most often been measured by the type and quality of the existing timber stand. But what if there are no trees? Now, researchers have come up with two techniques to help the forester out of his dilemma. One uses understory indicator plants and the other uses physiographic features to estimate site index. Details are included in two reports published this year.

The Wheeler Creek Research Natural Area preserves a fine stand of coast redwood at the northern limit of its range. Dedication May 3, 1973, brought together a distinguished group of forestry officials: left to right, Ted Schlapfer, Regional Forester; Bill Ronayne, Forest Supervisor; Undersecretary of Agriculture J. Phil Campbell; Chief of the Forest Service John R. McGuire; Robert E. Buckman, Director of the Pacific Northwest Experiment Station; and Russ Kahre, District Ranger.

Public Involvement Procedures Analyzed

The Experiment Station, through its recreation research unit at Seattle, has been involved this year in a nationwide study of the public involvement procedures used by the National Forest System. A recently-published report, "Public Involvement and the Forest Service," summarizes the experience and effectiveness of these programs and suggests directions for the future.

100th Research Natural Area Dedicated

This has been a highly successful year for the Research Natural Area program, a cooperative effort of several federal and state agencies in the Pacific Northwest. In May, we sponsored the dedication of the 100th Research Natural Area on Forest Service lands. This 334-acre tract of redwood in the Siskiyou National Forest represents a milestone in a program begun in the 1920's and symbolizes the progress many Federal agencies and cooperators have made in establishing a national system of Natural Areas. The stand of coast redwood, sequoia sempervirens, near the northern limits of its range will be used for scientific study, research, and educational purposes.

It is particularly appropriate that the 100th area was dedicated in the Pacific Northwest, for more natural areas have been established in this region than any other. Since 1931, 29 areas have been established in Oregon and Washington to preserve examples of many of the principal western forest types, including Douglas-fir, ponderosa pine, western redcedar and hemlock, western white pine, noble fir, Port-Orford cedar, and others.

In November, a three-day workshop on natural area needs for Oregon and Washington was held for cooperating state and federal agencies, universities, and The Nature Conservancy. A tentative list of needs developed from the workshop will be published by the Experiment Station as a guide for future needs in the Natural Area program.

Fish Habitat Studied

A new research effort is underway to find ways to improve the habitat for anadromous fish, including salmon and steelhead. Research grants were made to the Fisheries Research Institute of the University of Washington and to the Department of Fisheries and Wildlife at Oregon State University to study different aspects of fish habitat. Two research reports have resulted. Technical Report PNW-10 outlines the effect of logging on fish of the western United States and Canada. The other is on the biological effects of log rafting and storage in estuarian waters of southeast Alaska. While more study needs to be done on this problem, scientists did find that the abundance of aquatic insects was reduced in bark-covered areas and inter-tidal raft storage areas. Another finding is that organic compounds which leach from logs precipitate in salt water and probably have little effect on fish in the natural environment.

Study Begun on Poria Root Rot

Foresters have become increasingly concerned about the damage caused by the root rot *Poria weirii.* This fungus disease affects both young and old trees, and causes yearly losses of about 32 million cubic feet of mature Douglas-fir timber on the west-side Cascades alone.

Forest pathologists have identified several possible methods of control: (1) Planting red alder as a biological control; (2) fertilization with nitrogen; (3) mechanical control by uprooting diseased stumps and roots; and (4) planting relatively resistant tree species. During the past year a research effort was started to test these techniques. Cooperators include the Experiment Station, International Paper Company, Crown Zellerbach Corp., Port Blakely Mill Co., Oregon State University, and the Mt. Hood and Siuslaw National Forests.

Investing in Cultural Practices

There are very few opportunities to increase timber production in the Pacific Northwest in the next 30 years. This conclusion comes from a study of "The Land Base for Management of Young-growth Forests in the Douglas-fir Region," Research Paper PNW-159. The reason is that there are too few acres on which thinning, fertilizing, and other cultural techniques would efficiently increase production. But there are numerous opportunities to increase production in the long term by planting nonstocked, understocked, and hardwood or brush-covered areas.

Forest Residue Studies Underway

Two years of research in the forest residue reduction program is beginning to pay off. The staff is completing a major compendium on the effects of forest residues and residue treatments on the environment in the Pacific Northwest. This publication will include all the pertinent information on residues now available. The work will aid resource managers in planning adequate residue reduction programs, help satisfy requirements of the Environmental Protection Act, and serve as a basis for planning future research programs.

A second publication is a cooperative effort involving the Pacific Northwest Region of the Forest Service, the Experiment Station, forestry departments in the States of Oregon and Washington, other federal forestry agencies, and the forest industry. This report will contain detailed guidelines for treatment of previously unmerchantable wood left after logging. The "how to" guide and the residues compendium are expected to be published in 1974.

Skyline Logging Feature of Symposium

The increasing concern about environmental protection has accelerated a trend toward the use of aerial logging systems which help keep logs and equipment off the ground and reduce erosion. Special attention has been focused on skyline logging, the most economical of the three major methods of aerial logging (skyline, balloon, and helicopter).

A symposium sponsored jointly by the Experiment Station, the University of Washington, and Oregon State University, was held in January, 1974, and helped bring the story of skyline logging to over 600 people from the United States and Canada. Innovations reported by the Forest Engineering staff include: (1) A systematic approach to evaluating yarding systems capabilities; (2) a quick method of analyzing complex multi-span skylines; (3) a new approach to logging cost analysis; and (4) a desk-top computer system for timber sale layout and road design for skyline logging.

Aerial Logging Systems Studied

The $5 million Forestry, Advanced Logging, and CONservation program (FALCON), approved by Congress for fiscal year 1974, was one of the programs held up by the Office of Management and Budget. Funds were never released. We are hopeful that portions of the FALCON effort can be recovered through other research programs, and some related work is being continued.

One research and demonstration project, conceived originally as part of the FALCON program, is the Pansy Creek Advanced Logging project in the Mt. Hood National Forest. Timber sales are designed to demonstrate the feasibility of skyline, balloon, and helicopter logging on steep slopes and for special uses such as thinning or other partial harvests. Logging began in 1973 and will continue in 1974.

Engineer Hilton H. Lysons (above) discusses pros and cons of skyline logging during 1973 Society of American Foresters tour of the Pansy Creek project.

Energy from Wood

The energy of the sun is locked inside every living thing. Trees are an abundant source of this energy, and there is renewed interest in converting wood, especially logging residue, to energy.

What are the possibilities for using wood waste for energy in the Pacific Northwest where both wood and water resources are relatively abundant? A preliminary study indicates that generation of electricity from wood residue is not generally practical here; at least at this time. The major drawback is the high cost of collecting and transporting wood to the conversion site. It appears to be more practical to use residues for chip production, and burn the unused portions for process steam and/or electricity at industry plants where wood and bark fuel can be obtained at less cost than oil.

Brushfield Reclamation

The productive capacity of millions of acres is lost each year because of brush and other vegetation that competes with conifers on high site lands in the Oregon-Washington Coast Ranges. Recognizing this problem, economists have teamed up with brushfield reclamation experts to begin research into the economics of reclaiming these unproductive lands. This study will be based on a survey of present reclamation practices and will provide forest managers with guidelines to determine when and how brushfields can be economically reclaimed.

New Timber Cruising Grades Developed

A new system has been developed for grading old-growth coast Douglas-fir sawtimber. About 10 billion board feet of this species is harvested annually in western Washington, Oregon, and northern California. Field tests indicate that the new log grades have several advantages over the systems presently in use. For example, they are more accurate, easily understood by cruisers, and are applicable throughout the coast Douglas-fir region.

Douglas County Inventory Begun

The fourth inventory of the forest resources on non-Federal lands in the State of Oregon began in 1973 with a resurvey of Douglas County. The last inventory was done in 1962. Some 217 one-acre sample plots were remeasured to develop estimates of the extent and condition of forest lands in the county. Statistical data from the study will be published in 1974, when the field work for Jackson, Josephine, Coos, and Curry Counties will also be done.

Causes of Landslides Sought

Three western Forest Service Experiment Stations are cooperating in a study to investigate the impact of forestry activities on landslides in shallow granitic soils typical of the Coast Ranges in Oregon, Washington, Alaska, northern California, and the mountain regions of Idaho. The research is an extension of studies already underway on erosion processes—soil creep, mass movement, and landslides. Research will provide scientific information about the causes of landslides, help forest land managers predict where they might occur, and find ways to control them. Other Stations cooperating in the effort are the Pacific Southwest Station in Berkeley, California, and the Intermountain Station at Ogden, Utah.

Irrigation and Summer Rainfall

What is the effect of irrigation on rainfall? This question has often been raised in regard to the Columbia River Basin in Oregon and Washington. Irrigation began in the early 1950's. Some have claimed that summer precipitation in the basin has increased as much as 25 percent as a result. Research disproves this. Scientists at the Forestry Hydrology Laboratory in Wenatchee, Washington, have studied precipitation records back to 1924 and looked at growth rings in sagebrush to see if they could identify a change in precipitation trends. None was found. From this, researchers also conclude that there would be little or no climatic effect from disposal of sewage or power plant wastes in wildland areas.

Harvest Systems Discussed

Experiment Station scientists contributed 8 of 37 chapters to Agriculture Handbook No. 445, "Silvicultural Systems for the Major Forest Types of the United States," published by the U.S. Department of Agriculture. This handbook summarizes the silvicultural systems that are biologically feasible for the most important forest types in the United States. Advantages and disadvantages of each timber harvest system—selection, shelter wood, seed tree, and clearcutting—are detailed. This information is especially important now because of current controversies over clearcutting in several forest types.

Wildfire in the Taiga

The role of "Wildfire in the taiga of Alaska" is a paper by L.A. Viereck, published in the October, 1973, Journal of Quaternary Research. The paper is a summary of the work of our research staff at Fairbanks. It reviews the importance of fire in creating a vegetation mosiac in the taiga of Alaska which covers much of the interior from the Brooks Range south to the Coast Range.

Fire has always been a part of this environment; if it is totally excluded, some major ecological changes will result. An average of 10 million acres burns each year. On permafrost soils, fire may be essential to the recycling of ecosystem nutrients. Fire fighting efforts (with the use of large machines) may cause the underlying permafrost to thaw, resulting in soil movement and erosion. Some wildlife species such as moose and snowshoe hare depend on fire, but it may have harmful effects on caribou winter range.

Viereck recommends an increased program in fire research in the taiga of Alaska as a basis for the more intensive land planning and management that will result from the Alaska Native Claims Settlement Act.

Natural Vegetation Revised

The 417-page book, "Natural Vegetation of Oregon and Washington," by Jerry F. Franklin and C.T. Dyrness is an extensive revision of another book published in 1969 by the same authors. The improved version includes new data on plant associations, new soil classifications, updated plant names, and three indexes—by plant community, plant species, and general subject matter. The book will be of special use to botanists, geographers, ecologists, foresters, and other professionals in land management agencies.

Young Douglas-fir seedlings benefit from partial shade, but once established, grow best in full sunlight. This conclusion is one of several reported in Agriculture Handbook No. 445. All even-aged management systems—clearcutting, seed-tree, and shelterwood (above)—are suitable for culture of Douglas-fir. Selection cutting is not.

In another 1973 report, Paper 848, "Effects of Various Harvesting Methods on Forest Regeneration," Jerry F. Franklin and Dean S. DeBell point out the benefits of shelterwood harvest in Douglas-fir. Clearcutting is quite appropriate, they say, but by no means biologically necessary for regenerating even-age stands of Douglas-fir. The shelterwood technique has proved capable of providing fully stocked stands over a wide range of site and stand conditions.

Pacific Northwest Forest & Range Experiment Station

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Ecology of Southeastern Alaska Forests—Donald C. Schmiege
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